



DIGITAL AUDIO SYSTEM FOR RADIO STATIONS

BACKGROUND OF THE INVENTION

1. Field of the Invention

5 The present invention relates generally to a digital audio system for radio stations, and more particularly pertains to a programmable digital audio system for radio stations wherein the music to be played and broadcast over the radio station is stored in a
10 digital database from which it is recalled pursuant to prior programming of the operation of the radio station.

2. Discussion of the Prior Art

Recording of audio music has progressed significantly over the past decade. The introduction of
15 digital audio music has created a revolution in the quality of sound available for home users and for radio stations nationwide. The compact disk has become the standard for high quality digital audio, and has had a high acceptance rate in the marketplace.

20 In a typical prior art radio station environment, the disks to be played and broadcast are located and retrieved from a CD musical library. The disks are then loaded into a CD player, the music cued to play, and subsequently the disks are returned to the
25 library after play, actions which require time, labor, money and space. With the latest developments in computer technology, many of these steps can be eliminated to result in bottom-line savings to a commercial radio station.

30 SUMMARY OF THE INVENTION

Accordingly, it is a primary object of the present invention to provide a digital audio system for

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1 radio stations wherein the broadcast music is stored in
a digital database to provide a programmable radio
station.

The concept of the present invention is
5 relatively straightforward; instead of having the music
exist on compact disks, the music is stored in a common
digital database which is present in a computer system.
The operator only needs to point an arrow at the name of
the desired song to be played, press a button and the
10 music is then immediately played in full digital sound.
The order of the songs can be programmed in advance and
played without staff intervention. Commercials and
station promotions can be inserted as needed.

The database is created by loading desired CD
15 tracks from the station CD library once, and additional
songs can be loaded as necessary. Once the database is
created, the compact disks need not be used again; all
music is played directly from the database.

Another feature of the present invention
20 improves the system operation and performance even more.
If a song is not available in the radio station's
database, it can be transmitted to the system upon
request over a telecommunications link that provides
music from a master library database to the station's
25 system.

Each system can be customized to the station's
operational procedures. The system can adapt current
forms and provide any reports that the station currently
requires, and station logs can be maintained auto-
30 matically. All required FCC logs can be automatically
recorded, summarized, and printed as required.

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1 The present invention provides substantial cost savings in the operation of a commercial radio station in the following areas:

 In staffing, fewer people are required for the
5 station operation. Compact disks no longer need to be taken from the library and returned after each play. People are not needed to cue songs to play, as it is automatically handled by the system of the present invention.

10 In space savings, large music libraries are no longer necessary. Music is loaded once in advance into the system, and the source of the music (e.g., CD) need not be stored or saved.

 In equipment savings, fewer tape/CD players
15 are necessary, resulting in dramatic maintenance cost savings.

 In efficiency, the system of the present invention is very easy to operate. The person in charge of programming selects the music to be played and places
20 the music in a desired program order. A prior day's program can be used as a guide in planning future programming. The system then validates the selections and requests the loading of any material not present either by tapes/CD's or by downloading if available.

25 Work station consoles are available throughout the station for use by engineers, DJ's and others responsible for station operation.

 In reliability, a backup computer system automatically takes over for the primary computer system
30 in case of failure. All music in the database can have a second standby copy available and backup power to take

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1 over in an emergency, to operate the system in a fail-safe mode.

Listener response can also be implemented into the digital audio system for radio stations of the present invention. A listener call-in number can be tied into the system so that requested songs can be automatically played. Songs can be selected by a touch-tone phone without involving station personnel. A connection can also be made available to local interactive cable TV networks such that subscribers can have the same capabilities via the television set. Listener demographic information can be easily collected, which can be used for advertising, promotional, or programming purposes.

15 The system of the present invention revolutionizes the way that radio stations operate. Ease of use, cost savings, and increased station efficiency provide a quick return to the station. Additional features and options such as user call-in via telephone or interactive cable television provide tremendous marketing opportunities resulting in more listeners and higher advertising revenues.

In accordance with the teachings herein, the present invention provides a digital radio broadcast station which includes a common digital database having stored therein a plurality of at least several hundred different selections of music to be played and broadcast by the radio station. A processor system is provided for programming the digital radio broadcast station with a sequence of music selections, which are subsequently

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1 retrieved in order from the common digital database and
played over the digital radio broadcast station.

5 In greater detail, the processor system
includes a main computer system for operating the radio
station, and also a backup computer system for operating
the radio station in the event of a failure of the main
computer system. In that regard, a fiber optic cable
connects the main computer system with the backup
computer system for switching between the main and
10 backup computer systems. The processor system is
preferably based upon Reduced Instruction Set Computing
(RISC) architecture. The processor system preferably
comprises an IBM RS/6000 system with an AIX operating
system, and also includes first and second disk drive
15 controllers. The common digital database comprises a
disk array storage, preferably a dual port RAID disk
array. The digital radio broadcast station also
includes a plurality of work station consoles for use by
personnel responsible for operating the radio station
20 such as disc jockeys and engineers. A bridged network
which may include a modem is also provided for
connecting the radio station to a further digital
database for music selections not stored in the common
digital database. The processor system is provided with
25 a connection to a telephone network, such that radio
station callers can communicate with the radio station
by a touch tone telephone. The processor system is also
provided with a connection to an interactive cable
television network, such that cable television viewers
30 can communicate with the radio station over the
interactive cable television network.

1 The present invention also provides a method
for operating a radio station which includes digitally
storing in a common digital database, of a computer
system, a plurality of at least several hundred
5 different selections of music which is to be played and
broadcast by the radio station. Pursuant to the method,
the computer system is programmed with a sequence of
music selections to be played by the radio station, and
the programmed sequence of music selections is
10 subsequently retrieved from the common digital database
and broadcast over the radio station.

 The method of operation preferably utilizes a
main computer system for operating the radio station and
a backup computer system for operating the radio station
15 in the event of a failure of the main computer system,
with the processor systems preferably being based upon
reduced instruction set computing architecture. The
main computer system and the backup computer system are
connected by a fiber optic cable connection for
20 switching between the main and backup computer systems.
The method of operation of the radio station also
provides a plurality of work station consoles for use by
personnel responsible for operating the radio station,
such as disc jockeys and engineers. In greater detail,
25 the step of digitally storing includes digitally storing
the plurality of at least several hundred different
selections of music in a disk array, preferably a dual
port RAID disk array. The method of operation of the
computer system also provides a bridged network which
30 may include a modem for connecting the radio station to
a further digital database for music selections not

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1 stored in the common digital database. The method for
operating the radio station also includes inserting
commercials and station promotions into the sequence of
music selections to be played by the radio station. The
5 method of operation of the radio station also provides a
connection to a telephone network, such that radio
station callers can communicate with the radio station
by a touch tone telephone, and further provides a
connection to an interactive cable television network,
10 such that cable television viewers can communicate with
the radio station over the interactive cable television
network. The method of operation of the radio station
also provides a plurality of work station consoles for
use by personnel responsible for operating the radio
15 station such as disc jockeys and engineers. The step of
digitally storing includes storing the plurality of at
least several hundred different selections of music in a
disk array, preferably a dual port RAID disk array.

Pursuant to the teachings of the present
20 invention, the common digital database, either at the
radio station or provided elsewhere, can also be used to
provide an audio on demand service or system. In the
audio on demand system, a communications network is
provided to users, wherein a user communicates with the
25 computer system over the communications network to
indicate a choice of one or more music selections. The
choice of one or more music selections is then retrieved
from the common digital database and transmitted over
the communications network to the user.

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1 In greater detail, the communications network
can be provided by a telephone system, wherein a user
communicates with the computer system by a touch tone
telephone to indicate a choice of one or more music
5 selections, and the one or more music selections are
then transmitted over the telephone system to the
caller. The communications network can also be provided
by an interactive cable television network, wherein a
user communicates with the computer system over the
10 interactive cable television network to indicate a
choice of one or more music selections, and the one or
more music selections are then transmitted over the
interactive cable television network to the user.

BRIEF DESCRIPTION OF THE DRAWINGS

15 The foregoing objects and advantages of the
present invention for a digital audio system for radio
stations may be more readily understood by one skilled
in the art with reference being had to the following
detailed description of several preferred embodiments
20 thereof, taken in conjunction with the accompanying
drawing wherein Figure 1 is a block diagram of an
exemplary embodiment of a digital audio system for radio
stations constructed pursuant to the teachings of the
present invention.

25 DETAILED DESCRIPTION OF THE DRAWINGS

A digital audio system for radio stations
pursuant to the teachings of the present invention can
be implemented with the computer hardware illustrated in
Figure 1, which shows one preferred embodiment of a
30 Local Area Network (LAN) for a digital audio system for
a radio station. The Local Area Network includes a

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1 first RS/6000 processor 10, a second redundant RS/6000
processor 12, a plurality of work stations 14a, 14b,
14c, a Dual Port RAID Disk Array 16, an Ethernet bridge
and modem 18 to connect the LAN to a Wide Area Network
5 (WAN), and connections 20a for stereo audio outputs to
the radio station transmitter, 20b to telephone lines,
and 20c to interactive cable television systems.

Pursuant to the teachings of the present
invention, at least one processor 10 is required, but to
10 provide for optimum performance, a processor system
based on RISC (Reduced Instruction Set Computing)
architecture using two processors 10, 12 is preferred.
The processors 10, 12 accommodate the retrieval and
output of music stored in memory while providing
15 multiple users concurrent access to the system.

The processor system supports a high-
availability processing mode so if one processor system
10 fails, the other processor system 12 immediately
takes over without interruption, which is accomplished
20 via a fiber optic cable 22 linking the two processor
systems.

The processor systems 10, 12 preferably
provide hardware support for the output stereo audio,
and preferably are provided with input/output
25 connections based upon SCSI (Small Computer System
Interface), which allows connection of multiple compact
disk and disk storage units 24 (up to eight) as
required.

The processor systems 10, 12 support Ethernet
30 or Token Ring protocols to allow for the connection of
multiple terminal devices, such as the work stations 14,

1 and also to provide access to remote databases, as by a
bridged network which may include a modem 18, in a Wide
Area Network (WAN).

5 The processor systems 10, 12 are preferably
provided with multiple redundant connections 26 to the
disk system 16 to minimize the possibility of system
failure, and with connections 20b, 20c to telephone and
cable networks to provide for listener opinions and
requests.

10 Based upon commercially available equipment, a
preferred processor which fulfills the requirements of
the present invention is the RS/6000 system manufactured
by IBM Corporation with the following components:

- 15 a. 2 Gigabytes of disk storage in the
processor;
- b. a SCSI (Small Computer System Interface)
Differential Controller (to provide for connections 26
to the disk drives);
- c. 128 Megabytes of main memory;
- 20 d. FDDI (Fiber Data Distributed Interchange)
which is a Fiber adapter (single ring) port for fiber
optic connections 22 between the two processors;
- e. Audio capture/playback adapter (audio
output from machine to 20a);
- 25 f. Digital tape drive with 5.0 gigabyte
capacity for system backup (such as is available in Sony
camcorders);
- g. 4 (minimum) CD-ROM drives;
- h. a communications adapter which is for a
30 separate circuit card for connections to telephone/cable
systems.

1 Although not recommended, the dual RISC
configuration can be replaced by a single processor or
by one based upon a different architecture such as a
personal computer. However, if this substitution is
5 made, poor system performance or reliability may result.

 Regarding the disk storage 16, the primary
requirement for the disk storage is that an on-line
database of at least 30 gigabytes be available at any
time. This amount of disk allows for the storage of
10 approximately 1800 songs; additional storage can be
added as required. The disks are configured so that if
one disk unit fails, the system continues operation
without interruption.

 Additional hardware requirements include:

- 15 a. A second disk drive controller to take
over in the event that the first disk drive controller
fails;
- b. Access to the disk drive unit from both
processors;
- 20 c. Automatic duplication of all data onto a
backup disk drive unit; and
- d. The ability to easily replace failed
components without system downtime.

 These requirements are preferably met by a
25 disk technology called RAID (Redundant Array of
Inexpensive Disks). Using RAID, any storage subsystem
component or processor can fail without affecting the
overall operation of the system. The RAIDIAN ARRAY
product, available commercially from IBM, when equipped
30 with an additional array controller, fulfills these
hardware requirements.

1 Each work station 14 preferably consists of a
19-inch terminal display and a mouse connected via
Ethernet or Token Ring to the main computer system. A
minimum of three work stations 14a, 14b, 14c would
5 generally be required to be used by the following
individuals:

- a. Station Manager - responsible for
selecting and sequencing music and reviewing FCC logs
produced by the system;
- 10 b. Engineer - responsible for loading system
database and monitoring station operation;
- c. On-Air Personality (DJ) - responsible for
integrating the music sequence into an on-air program.

Each work station 14 display is preferably
15 configured to the function to be performed. For
example, the station manager's display can present
programming options, while the engineer's display can
present options relevant to the loading of music into
the database. A primary feature of the system is that
20 an individual with little computer experience can
operate the work station easily as all input is entered
by a graphical display.

Regarding communications equipment, the system
preferably has a connection to optional remote databases
25 via an Ethernet bridged network which may include a
modem 18 and high speed data communication lines. This
allows the system to access and download music which is
not present in the digital database memory of the radio
station's system.

30 Regarding computer software, particularly the
operation system, when using the preferred RISC based

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1 processor configuration, a preferred operating system is
AIX, commercially available from IBM Corporation, which
provides support for the hardware and for easy system
operation. Additional features of AIX include:

- 5 a. On-line access to system documentation;
- b. Support, control and design of the
graphical displays used to operate the system;
- c. Support for a high-availability processing
mode so that if one processor fails, a second processor
10 takes over immediately;
- d. The ability to access the music stored in
digital form and then convert it to audio which is then
broadcast by the radio station;
- e. Communications support to allow access to
15 remote systems and databases.

 The database manager will generally be custom
software written for a particular radio station. The
database manager stores the music so that it is
available to the radio station, provides the director
20 listings to the user, and determines in which computer
system the requested song is located. Due to the unique
requirements of the system, the database manager would
generally be specifically written for this application.

 While several embodiments and variations of
25 the present invention for a digital audio system for
radio systems are described in detail herein, it should
be apparent that the disclosure and teachings of the
present invention will suggest many alternative designs
to those skilled in the art.

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